

REVIEW

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professor in professional field 5.3. “Communication and Computer Engineering”
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**Concerning scientific works submitted for participation in competition for awarding the academic position of “Associate Professor” in professional field 5.3 “Communication and Computer Engineering”; scientific specialty “Communication Networks and Systems”, which was officially announced in State gazette, issue 58 from 23.07. 2019 and on the website of TU-Gabrovo to meet the needs of department “Communication Technologies and Equipment” which is a constituent unit of the Faculty of Electrical Engineering and Electronics;
with applicant: Chief Assistant Professor Ivelina Stefanova Balabanova, Ph.D.**

1. Brief biography details

Dr. Ivelina Balabanova was born in 1977 in the town of Gabrovo. In 1996 she graduated the local high school of natural sciences and in 2001 she graduated TU-Gabrovo with a bachelor degree in “Electronic engineering and technologies”. Later she was enrolled as full-time student in the Ph.D course taught in the department of Electronics. In 2007 she defended her doctoral thesis before the Higher Attestation Commission on “Infrared channels for information transfer, control and protection”. Ms. Balabanova has obtained her appointment as fulltime assistant professor in the subject “Signals and systems” at the department of Communications technology and equipment of TU-Gabrovo in 2005. Since 2007 she has held the position of chief assistant professor. So far Dr. Balabanova has authored and co-authored over 60 scientific publications, 6 teaching materials and 1 monograph. She is also a holder of certificates of covered levels in technical English, has acquired a teaching permit and graduated Cisco academy. Among the major areas of her professional interests are optical communications, modeling and analysis of traffic processes, artificial intelligence in telecommunications, digital filters and noise identification. Dr. Balabanova is a member of the “ Union in electronics, electrical engineering and communications” as well as of the “Union of scientists in Bulgaria”. She has successfully implemented two ERASMUS study grants in the University of Brno, Czeck Republic and Trakia University of Odrin, Turkey.

2. General description of submitted materials

I have been given 43 scientific works for reviewing, 37 of which are published at national and international scientific conferences and in journals of engineering; there is one monograph and 5 teaching guides on lab exercises. Said works are divided into several groups according to the number of authors, edition of issuance, language, impact factor and selection in referenced international data bases:

- 5 of independent authorship (№ 1,2,3,10,12);
- 32 co-authored;
- 19 written in English including 9 publications abroad (№ 4,6,7,8,26,29,32,33,35);
- 18 written in Bulgarian;
- 6 published in editions with ISSN abroad (№ 6,26,29,32,33,35);

- 12 published with ISSN in Bulgaria (№ 9,10,11,12,13,14,16,17, 18,19,22,23, 36, 37);
- 13 at scientific conferences with international participation held in Bulgaria (№1,3,4,5,15,19,20,27,28, 30,31);
- 4 at scientific conferences held abroad (№ 2,7,8,32);
- 2 with impact factor;
- 9 indexed in Scopus one of which is with IF;
- 1 with IF is referenced in Web of Science.

3. Reflection of candidate's scientific publications among the scientific community (known citations)

Concerning the information in the copyright reference about the number of citations, I can say that Dr. Balabanova is familiar to the scientific community both in Bulgaria and abroad due to the results of her research. This fact is confirmed by a total of 27 citations 17 of which are Bulgarian and 10 found in foreign/international editions. From materials in Bulgaria there has been found 1 citation in a monograph; 1 in a referenced publication Scopus and 7 in publications that are indexed in ROAD international portal. Concerning citations made abroad 8 have been found in Scopus international database, $h=2$ (Hirsh index).

4. Overview of content and results in the submitted works

I have divided into two major groups the materials authored and co-authored by Dr. Balabanova, which were submitted to me for reviewing:

- research in the field of optical communications and telecommunications transfer lines;
- research in the field of communications circuits, digital processing and identification of signals.

Publications [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 32, 33, 36, 37] plus the study guide [4] belong to the first group. In [1-4] there have been analyzed the processes during optical pulses transfer, the changes in attenuation parameters, dispersion, strength and reliability, the influence of CSO/CTB and CNR in high speed fiber optic systems, optical components and coaxial cable lines. Directions for selection of type of technology and configuring in optical nets setup are given in [5]. Proposals of methods for calculation of optoelectronic circuits, control of laser diodes in the infrared spectrum [6, 10]. There have been designed circuit solutions for generating de-phased pulses conversion of luminance and two types of luminance into frequency, a multichannel temperature measuring device [7, 8, 11]. Based on modeling of variety of routing of WDM nets, there has been derived a model of defining failure probability [9]. In [12-14] are investigated teletraffic processes with star and ring topology, asymmetry of channels in cable TV nets with proposed DOCSIS strategy for reducing the problems due to that asymmetry. Similarly, there has been analyzed the transfer of MPEG encoded video signals. Identification has been done of teletraffic systems with evident losses based on the incoming traffic and the information channels through the instrumentality of triple layer artificial neural nets and a model according to the decision tree method [15, 16, 17]. Also synthesized are classification models on the basis of k-NN nearest neighbors method, artificial neural networks and adaptive neuro-fuzzy interface systems plus the analysis of relationships between certain factors with and without experimentation plan, the object of investigation being “ teletraffic model of voice sources” [18, 20, 21, 22, 26]. LabVIEW applications have been developed for recognition and classification of telecommunications systems and devices [19, 23, 24, 25]. In imitation modeling of Markov chains, based on

experimentation planning and regression diagnostic, there have been obtained mathematical models for forecasting parameters of input and output traffic [32, 33, 36, 37].

A guide for lab exercises has been developed for the purpose of studying principles and processes in “Switching and multiplexing technique” [4].

To the second group of materials for reviewing belong publications [27, 28, 29, 30, 31, 34, 35], study guides [1, 2, 3, 5] and the monograph [6]. By means of LabVIEW there have been developed virtual applications for generating signals and noises, designing and investigation of characteristics of digital IIR and FIR filters according to various approximations and algorithms, signal filtration and statistical analysis of parameters’ data. A similar set of methods has been developed by means of a set of graphical user interfaces in MATLAB [27, 28]. Neural models have been developed for computer modeling of digital recursive and non-recursive filters based on filter coefficients as well as on the basis of neuro-fuzzy architectures for recognition and classification of noise influence upon analogue and digital signals [27, 29, 35]. In [30] are found the results during quality evaluation of linear discriminant models as well as the correctness of analysis in the identification of noise polluted electric signals. Internet-based systems have been developed for integration of virtual applications for computer modeling and investigation of behavior of IIR and FIR filters as well as Microsoft SQL and MySQL storage of results [27, 31, 34].

Dr. Balabanova has also written a series of lab exercises study guides in the subject “Communications circuits” [1, 2, 3]. There has been compiled a study guide for designing digital filters for identification of signals with added noises for the purpose of lab exercises applicable in the subjects of “ Signals and systems”; “ Digital processing of signals” and “Communications circuits” [6].

Also in connection with her habilitation procedure, Ms. Balabanova has submitted her independent author’s monograph, which is related to processing and analysis of analogue and digital signals with available background noises, based on hardware training and estimation of results. The candidate has also formulated some contributions with regard to her research which I have accepted.

5. General characteristic of candidate’s activity

5.1. Teaching and pedagogical activity (work with students and postgraduate students)

Chief assistant professor Dr. Ivelina Balabanova has worked in the department of “Communications technologies and equipment” at TU-Gabrovo since 2005.

She teaches a wide set of subjects both at TU-Gaborovo and Technical College – Lovech to fulltime and part-time students studying in bachelor and master degree courses in “Mobile and Satellite Communications” and “Communications Technologies and Equipment”. The courses of lectures she reads to 3rd and 4th years students include “Communications circuits”, “Switching and multiplexing technique”, “Telecommunications transfer lines” , “Theory of teletraffic” , “Optical communications“ and “ Electromagnetic compatibility”.

So far she has been academic advisor to 38 bachelor degree graduates and 18 master degree graduates. She also has reviewed graduate thesis works of 53 students and participated in state examination panels for students who majored in “Mobile and satellite communications” and “Communications technologies and equipment”.

Dr. Balabanova possesses skills and competencies which she employs in her teaching and research plus the ability to make use of software products such as Java Modeling Tool, MS Office, LabVIEW, Multisim, MATLAB, STATISTICA, Visual Basic, Altium Designer, Cisco

Packet Tracer, Microsoft SQL, MySQL as well as a variety of program languages such as C, C++, HTML, SQL, PHP, CSS and JavaScript.

Likewise she has also provided academic advising to students participating in the university undergraduate scientific session.

5.2. Scientific and applied research activity

The candidate has participated in 7 research projects under UCRT(University Center for Research and Technologies) at TU-Gabrovo. One of these was a joint project implemented during 2009 in partnership between TUG and the Ministry of Economy, Energy Supply and Tourism.

Her scientific and applied research work addresses development and implementation of applications for improvement and expansion of QoS service in data transfer and analysis in communications and is directed at the following technical fields:

- Design and investigation of tele-traffic processes and systems;
- Optical communications and computer networks;
- Regression and correlational analysis;
- Artificial intelligence and neuro-fuzzy systems;
- Design and research of digital filters;
- Digital processing and analysis of signals;
- Application of Data Mining devices in communications and others.

So far Dr. Balabanova has been awarded with several prizes and awards at various scientific forums held in University of Russe in 2015 to 2017. She also is a prize winner in the International Conference held under the auspices of IEEE – “Black Sea Com” in 2016.

5.3. Implementation activity

The candidate has implemented numerous lab exercises and setups related with the subjects she has taught, namely:

- Modeling of Markov chains with limited and unlimited calls in the queue,
- Investigation of the influence of attenuation of signals through optical components in setting up PON networks,
- Design and analysis of recursive and non-recursive filters and filtering of signals with LabVIEW and MATLAB,
- Simulation modeling and practical research of IIR filtering devices of various orders based on Chebishev approximation and others.

In „VIDEOSAT KTC” company, represented by its manager Mr. Kiril Nikov, there has been implemented a project for quality improvement of QoS during transfer of TV signals via Internet.

6. Contributions (scientific, applied research and application)

I have divided the materials submitted for reviewing as belonging to “applied research” and “application”.

Applied research contributions in the field “Research in optical communications and telecommunications transfer lines”:

- Here are proposed methods for calculation of parameters during designing optoelectronic analogue circuits and drivers for control of infrared laser diodes;

- Models are defined related to failure probabilities in networks with spectral multiplexing and properties connected with the decrease of asymmetry impact in channels of cable TV nets;
- For the purpose of improving service quality there have been presented techniques for investigation of processes during optical pulses transfer and analysis of CSO/CTB and CNR influence in fiber optics systems;
- The applicability of artificial intelligence has been investigated in identification of tele-traffic systems with evident losses, models of voice sources, Markov chains which combine various types of traffic streams; Neuro-fuzzy qualifiers have been synthesized for the purpose of qualitative and quantitative analysis concerning parameters of tele-traffic models;
- Models have been selected through the instrumentality of decision tree and k-NN for the purpose of identifying teletraffic systems with evident losses, Markov chains with limited and non-limited places in a queueing set, models of voice sources and systems which combine different types of traffic flows;
- Regression models have been designed for determining the average timeout within the system as well as the probability of losses with teletraffic model of voice services based on experimentation planning;
- Also analyzed is the influence of the intensity of incoming calls λ_1 and the time t_d , with and without experimentation planning, upon the average timeout in the system plus the probability of losses in the voice service system;
- Polynomial models have been obtained based on regression analysis for forecasting the moment of incoming and the moment of release of processed calls concerning Markov chains with one or more assigned servers with application of experimentation plans.

Application contributions in the field of “Investigation in optical telecommunications and telecommunications transfer lines“:

- Electronic devices have been designed for generating of phase shifted pulses, conversion of luminance in a series of pulses and two types of luminance into frequency;
- There has also been developed a virtual set of tools for the purpose of testing neural and neuro-fuzzy identification of teletraffic service devices and analysis of data flow

Applied research contributions in the field of “Investigation in communications circuits, digital processing and identification of signals“:

- Author’s monograph has been written based on the experimental investigations concerning objects of identification and determining the noise level in analogue and digital signals with the help of:
 - ✓ Trilayer and multilayer artificial neural networks according to Levenberg-Marquardt and Scaled Conjugate Gradient algorithm;
 - ✓ Neuro-fuzzy systems according to Hybrid and Backpropagation algorithm;
 - ✓ Probability apparatuses such as discriminant analysis and classification according Bays algorithm with Gauss and Kernel distributions of input variables;
 - ✓ Graphic structures for multiple choice selection of solution;
 - ✓ Regression diagnostics.

- There has been proposed a set of methods for generating random signals, design of recursive and non-recursive filters, filtration and statistical analysis of signals with the application of GUI in MATLAB medium;
- Linear discriminant and neuro-fuzzy classification models have been investigated in defining the property of electric signals with overlaid noises respectively “Periodic Random Noise and Inverse F Noise“ and “Uniform White Noise and Inverse F Noise“;
- Multilayer intelligent architectures have been synthesized during recognition and classification of clear signals and signals with available types of noise;

Application contributions in the field “Research in communications circuits, digital processing and identification of signals“:

- LabVIEW applications have been developed for the purpose of simulation investigations of algorithms for design of IIR and FIR digital filters;
- Microsoft SQL and MySQL relational structures have been developed based on analysis and manipulation of data belonging to filtration of signals processes.
- Implementation in the process of instruction and teaching of WEB data platforms for LabVIEW computer modeling and diagnostic of digital filters’ functionality and the quality of filtered signals with administrating of users access to Microsoft SQL and MySQL servers.

7. Evaluation of candidate’s personal contribution

On the grounds of the materials submitted to me for reviewing I evaluate the contributions of Dr. Balabanova as substantial, diverse and wide-ranging in terms of fields pertaining to computer and communications technologies. In a large number of her publications she is the leading author which confirms her leading role concerning obtained outcomes. Ms. Balabanova employs modern methods and means, develops, adapts and implements innovative virtual tools and methods in her research practice. The presented monograph is worth a special note for its quality and applicability connected with Data Mining processes in electric signals processing.

8. Critical notes and recommendations

I could point out the following critical notes concerning the materials submitted for participation in the competition:

- it would be more appropriate if the contributions, presented by the candidate, were divided into categories of applied research and application. In this way they could be formulated in a far better manner and kind;
- there are some repetitions and stylistic inaccuracies in the exposition of some publications;
- publication [32], designated as indexed in Web of Science, is in fact a material that has been published in a foreign journal;
- actual number of publications indexed in Scopus data base is 9 and one of the materials with Impact Factor [6] is referenced only in Web of Science;
- the candidate has not submitted any reference concerning her participation in project teams; similarly the subjects taught by her in the Technical College - Lovech were not indicated.

My critical notes should in no way belittle the candidate's contributions. I, hereby, advise chief assistant professor Dr. Ivelina Stefanova Balabanova to continue her research and publications in the fields she is actively involved in and look for opportunities for application her products and innovations.

9. Personal impressions

I know the candidate personally since 12 years ago, I have immediate impressions of his scientific, pedagogical and organizational activities. My opinion can be summarized as follows: Dr. Balabanova knows of scientific sources, professional and corporate literature and the current state of the competition field, especially in the field of the competitive discipline; She speaks Russian and English and uses them in her scientific activity; The applicant's work and broader interests go beyond the competitive scientific field, which is an advantage in the PhD competition; In addition to her creative work, she has built and developed laboratory exercises and stands for the learning process.

10. Conclusion:

With regard to what has been stated above I propose Chief Assistant Professor Dr. Ivelina Stefanova Balabanova to be awarded the academic position of “Associate Professor” in the area of higher education - 5. Technical Sciences, professional field – 5.3. Communication and Computer Engineering; scientific specialty: “Communication Networks and Systems”.

/signature/

23.10.2019 y.

Reviewer: /Prof. D.Sc. Raycho Todorov Ilarionov/